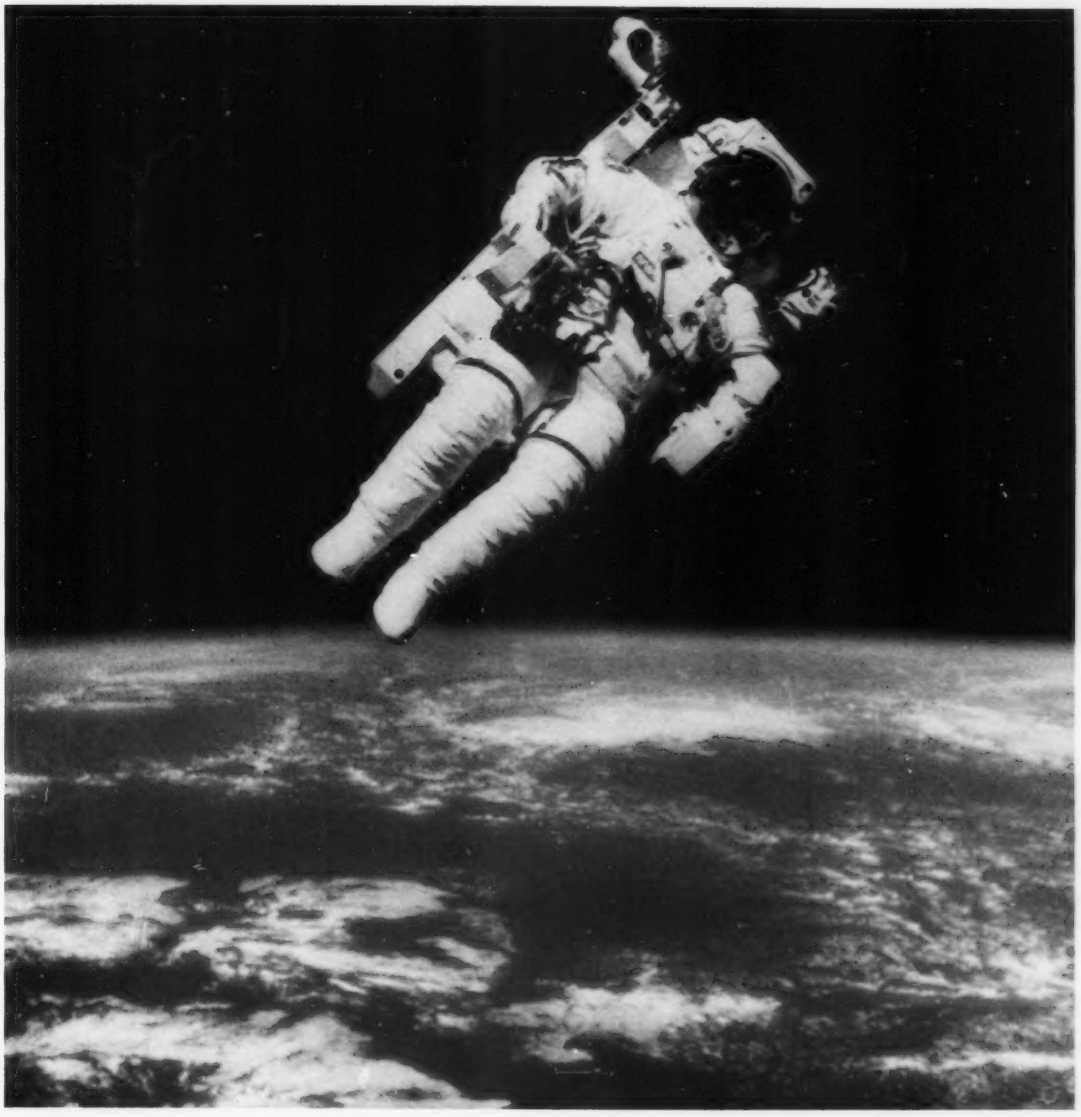
NASA Activities

National
Aeronautics and
Space
Administration

March 1984
Vol. 15, No. 3



About the Cover

During Shuttle mission 41-B (Feb. 3-11, 1984), mission specialist Bruce McCandless II became the first astronaut to walk untethered in space. This spacewalk represented the first use of a nitrogen-propelled, hand-controlled device called the manned maneuvering unit (MMU), which allows for much greater mobility than that afforded previous spacewalkers, who had to use restrictive tethers.

For more than five hours, McCandless and mission specialist Robert Stewart tested the MMU in space—close to the spacecraft and at translation distances as far as 300 feet. The astronauts said the MMU, the product of 18 years of development work, offered freedom and precision of movement heretofore unheard of in extravehicular activity.

In the cover scene, McCandless is a few meters away from the cabin of the earth-orbiting Space Shuttle Challenger.

Contents

Shuttle Mission 41-B—Pictorial Highlights 3
3M Announces Long-Range Basic Research Program in Space 7
New Evidence Found for Huge Volcanoes on Venus 7
Research Grants Awarded to Alabama A&M University 9
Shuttle Mission 41-C—Pre-Launch Statistics 10
Cinema-360 Camera System Documents Shuttle Flights 11
Crew Assignments Announced for Three Shuttle Missions 12
Tethered Satellite Development Underway 13
Headquarters Personnel Announcements 14
Contractor News 14
NASA Photo Techniques Help Preserve Fine Art .. 16
Patents for Inventions from NASA Research 17
What's New in NASA Television and Radio 18
1984 Launch Activity 19
Another Dividend from Air and Space 20

NASA Activities is published monthly by the National Aeronautics and Space Administration for the information of the agency's employees. Contributions and recommendations are solicited from headquarters and field centers, and should be addressed to Editor, NASA Activities, News and Information Branch, Code LFD-2, Washington, D.C. 20546. Material submitted for publication cannot be returned.

Distributed free of charge only to current agency employees. Available by Subscription via the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Check or money order should be made payable to Superintendent of Documents, GPO. Subscription rates are $20.00/year domestic; $25.00/year, foreign.

Barbara Selby
Code LFD-2
NASA Headquarters
Washington, D.C. 20546
Phone: (202) 453-8400

Shuttle Mission 41-B—Pictorial Highlights

Crew ..... Vance D. Brand, commander
Robert L. Gibson, pilot
Bruce McCandless II, mission specialist
Robert L. Stewart, mission specialist
Ronald E. McNair, mission specialist

Orbiter ..... Challenger (OV-099)

Challenger arrival at Kennedy Space Center (for launch preparation) ..... Sept. 9, 1983

Rollover to Vehicle Assembly Building ..... Jan. 6, 1984

Rollout to launch pad ..... Jan. 12, 1984

Launch site ..... Kennedy Space Center, Fla., Pad 39A

Launch date/time ..... Feb. 3, 1984; 8 a.m. EST

Mission duration ..... 7 days, 23 hours, 15 minutes, 54 seconds

Orbits ..... 127 orbits; landing 128th

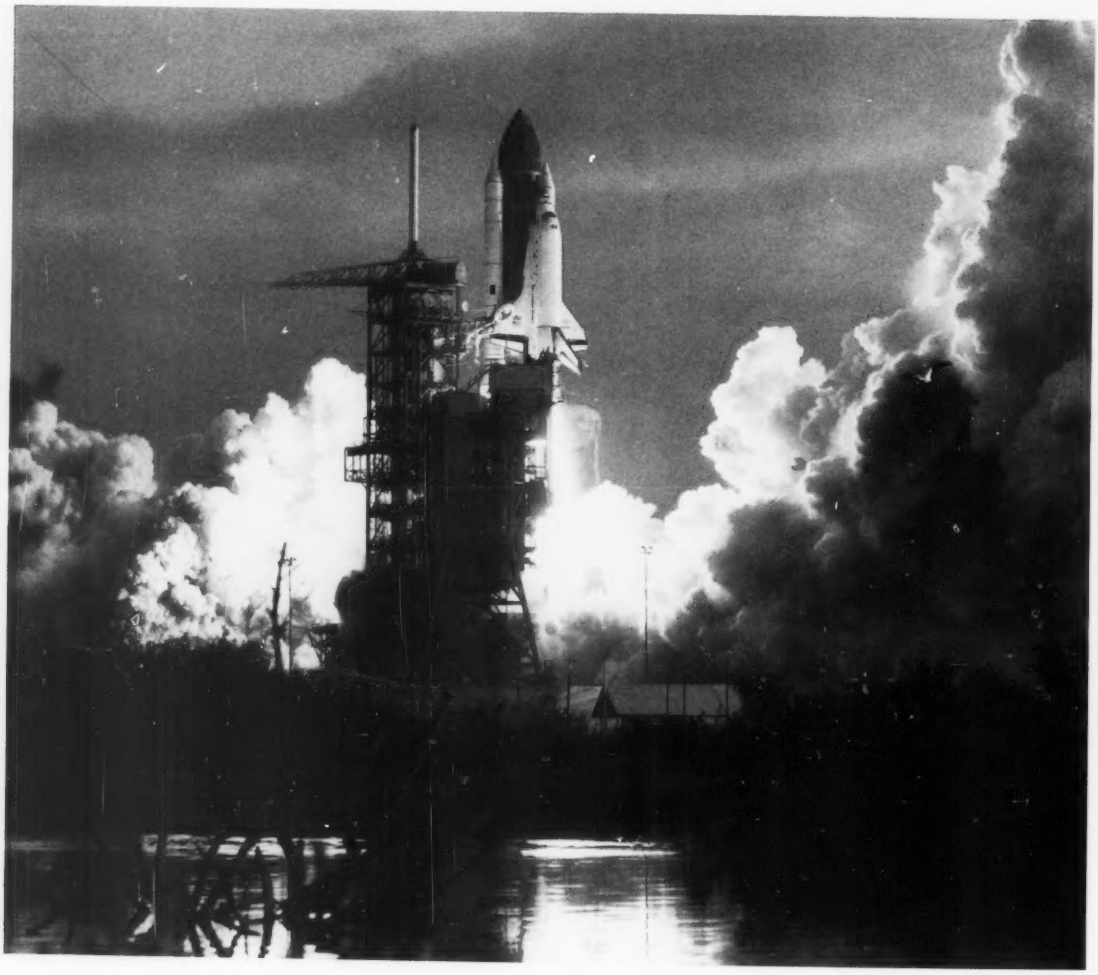
Landing date/time ..... Feb. 11, 1984, 7:15:54 a.m. EST

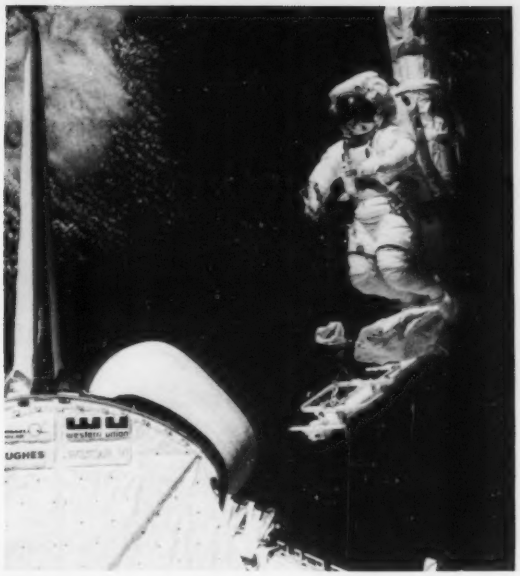
Landing site ..... Kennedy Space Center, Fla., Runway 15

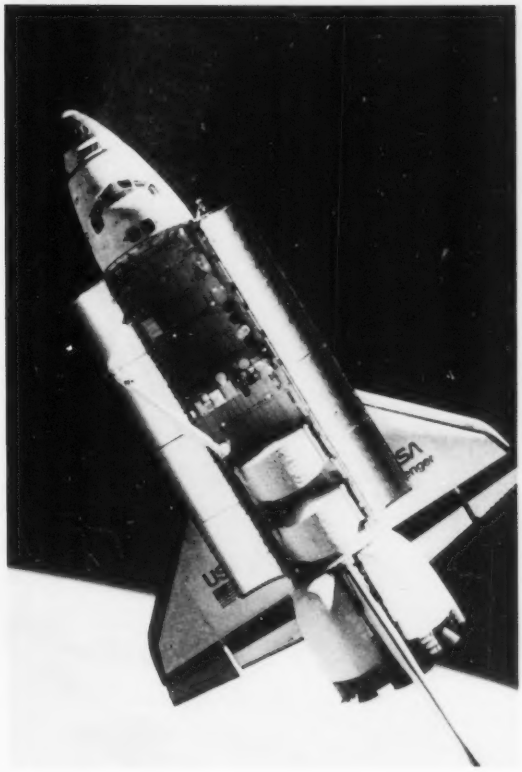
Mission firsts ... First flight Manned Maneuvering Unit
First extravehicular activity with no extended pre-breathe
First use of manipulator foot restraint
First KSC landing

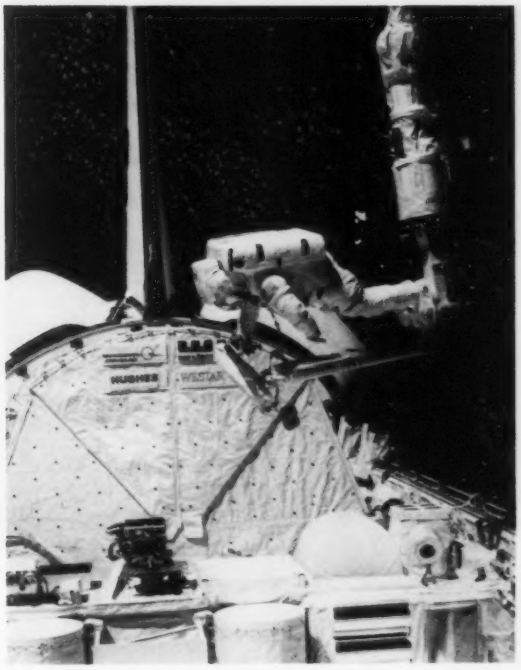
Technicians lower into place the Getaway Special canister containing the Cinema-360 movie camera system. Below, the 41-B vehicle is rolled out of the Vehicle Assembly Building to Launch Pad 39 A. The Launch Control Center can be seen immediately behind the moving crawler transporter.

Pre-launch crew breakfast (upper left); crew departs for launch pad (upper right); liftoff at 57.5 milliseconds after 8 a.m. EST.

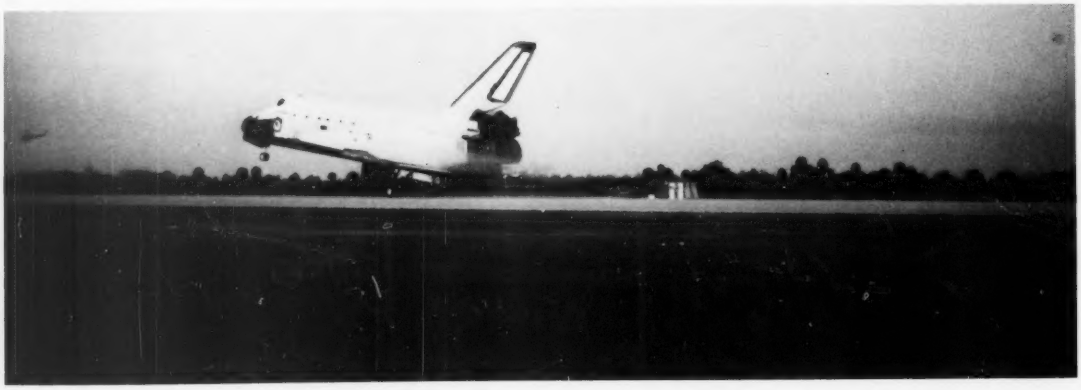




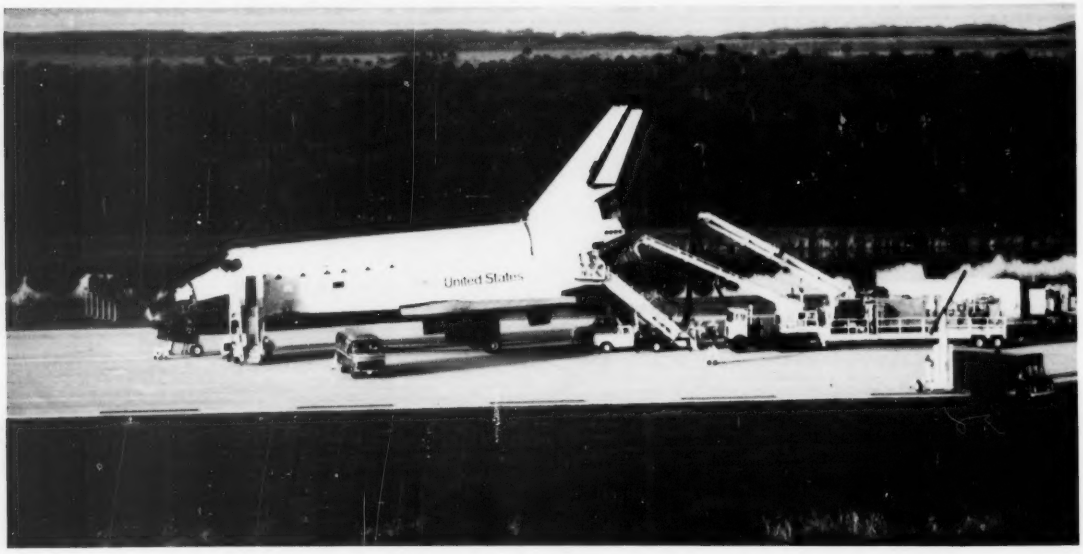




McCandless uses the combination of the remote manipulator system arm and the mobile foot restraint to experiment with a "cherry picker" concept; (lower left) a fixed camera on McCandless's helmet recorded this rare scene of Challenger's cargo bay.



Challenger touches down for the first landing at Kennedy Space Center about five miles from Launch Pad 39A, where the mission began eight days earlier. Below, ground crew members perform initial post-landing procedures.



3M Announces Long-Range Basic Research Program In Space

3M has announced the beginning of a long-range basic research program in space, with the aim of eventually producing commercial products in orbit.

Making the announcement at NASA Headquarters, Washington, D.C., on Feb. 8, were Lewis W. Lehr, 3M Chairman and Chief Executive Officer, and James M. Beggs, NASA Administrator. 3M is a worldwide manufacturing company with 86,000 employees in 53 countries.

Lehr said the company's initial experiments could be ready to fly aboard the Space Shuttle by August. The experiments deal with organic crystalline materials and the preparation of thin film that could have application in the fields of electronics, imaging, energy conversion and biology.

"We recognize that now is always the proper time to start building the future," Lehr said. "And 3M is pleased, now, to make a significant commitment to basic research and industrial investment in the future of space."

Declaring NASA "delighted," Administrator Beggs said the agency " stands ready to assist in this intiative." The two organizations, he said, "have agreed to work together to develop a plan to explore the space frontier for potential commercial applications in materials processing."

The 3M program of research in space is aimed at "advancing the state of the art in processing organic materials in the low-gravity and high-vacuum environment available in orbit," according to Dr. Robert M. Adams, 3M's Senior Vice President of Technology Services.

Adams said the first Shuttle flight experiments by 3M will relate to the prospects of growing crystals from organic materials that cannot be crystallized on earth because of the pull of gravity, and the development of thin films with novel physical and chemical properties.

Dr. Lester C. Krogh, 3M Vice President for Research and Development, said that a team of 3M scientists is designing apparatus and preparing experiments to go aboard the Space Shuttle.

They will seek answers in three areas of research, Krogh, said: "The effects of low-gravity and high-vacuum on materials processes we know we can do on earth, processes we know we can't do and some 3M proprietary technologies."

"What we are doing is to establish a data base about the processing of organic materials in space," he said, indicating that it might take several years for any new technology to find its way into commercial products.

3M previously has supplied NASA with a variety of space-program products, ranging from Fluorel elastomer for the boot soles of lunar astronauts to Nextel ceramic fibers for Space Shuttle heat shielding. Other 3M products used in the space program include a gold-foil tape to wrap the tether of previous space walkers and 3M's Comtal digital image-processing equipment to produce detailed color photographs from radio signals transmitted by the Venus space probe.

New Evidence Found For Huge Volcanoes on Venus

Scientists believe a massive volcanic eruption—dwarfing the largest earth eruptions—recently occurred on Venus. This adds to a growing body of evidence for gigantic active volcanoes on earth's twin planet.

A variety of findings, primarily by the Pioneer Venus spacecraft in orbit around the cloud-draped planet, point to this huge scale volcanism.

- A new analysis covering five years of findings by the Pioneer Venus orbiter indicates that concentrations of sulfur dioxide in Venus' atmosphere increased more than 50 times in 1978 and have been declining steadily ever since.

These findings were made by Dr. Larry Esposito of the University of Colorado, Boulder. They point to a large volcanic eruption, he says. A major increase in atmospheric sulfur dioxide normally occurs after volcanic eruptions on earth as well.

- Earlier Pioneer topographic maps covering most of the planet indicate that the mountain ranges of Beta Regio and Atla Regio (in the Scorpion Tail of Aphrodite Terra) were of the proper size and shape for volcanoes. Detailed analyses of Pioneer gravity sensing data also have shown that these two areas are unique in being formed from new rock, recently extruded from Venus' interior.
- Remarkably, repeated clusters of lightning bolts, very similar to lightning discharges generated in terrestrial volcanic plumes, have been discovered by Pioneer investigator, Dr. Fred L. Scarf of TRW, Inc., Redondo Beach, Calif. The lightning discharges are detected by Scarf's plasma wave instrument aboard the Pioneer Venus orbiter. A multitude of lightning events have been recorded directly above the surface of the Beta and Alta mountainous regions. These events are believed to be tied to the volcanic mechanism.

Esposito's Venus atmosphere findings also depend on data from the four spacecraft of the Pioneer multiprobe, which has measured Venus' atmosphere from top to bottom planet-wide. The Pioneer project is managed by NASA's Ames Research Center, Mountain View, Calif.

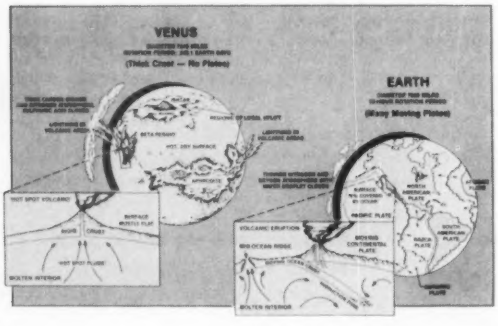
Beta and Atla Regio are the freshest-looking volcanic sites on Venus based on topography, gravity sensing data and radar altimetry images, according to Dr. Harold Masursky, of the U.S. Geological Survey, Flagstaff, Ariz.

Beta Regio has been interpreted as consisting of two enormous shield volcanoes, almost 2,400 kilometers (1,300 miles) in length, larger than the entire Hawaii Midway chain. This area appears to be the most volcanically active region on the planet. Images from Pioneer Venus and ground-based radar show radiating bright rays on Beta, indicative of very young lava flows. Measurements by a Soviet spacecraft also support this.

Beta is believed to sit over a powerful upflowing convective plume, deep in Venus' interior magma. Huge by any standards, Masursky believes the volcanoes on Beta may dwarf all other solar system volcanoes in volume, including Olympus Mons on Mars, currently the highest volcano in the solar system (three times higher than Beta).

Recent earth-based radar images show indications that Maxwell Montes is a huge ancient volcano. Maxwell is the highest point yet found on Venus, a mountain massif higher than Everest. It shows none of the signs of recent activity recorded for Beta and Atla.

The apparent huge volcanoes seem to be related to the planet's global heat balance. Although Venus appears to have the same internal heat sources as the earth, earth is able to vent its heat at many points, especially at the constantly expanding mid-ocean ridges. Scientists believe Venus, unlike the earth, has no mobile plate tectonics and, hence, no mid-ocean spreading regions where the crust is forced apart and liquid magma emerges almost continuously.



Rising up from Venus' great plains, about 30 degrees north of the equator is Beta Regio—apparently two huge shield volcanoes, larger in extent than the Hawaii-Midway chain, covering a north-south distance of 2,900 kilometers (1,300 miles). This artist's concept is derived from topography measurements by the Pioneer Venus orbiter spacecraft.

The huge volcanic outpourings of Beta and Atla are considered the planet's youngest form of heat escape. Upwelling plumes or "hot spots" in Venus' internal magma are proposed to have burned their way through the thick, rigid crust, venting the planet's internal heat, and creating giant volcanoes. A very similar process formed the earth's Hawaiian Islands.

The new findings are exciting since the physical characteristics of earth and Venus are almost identical. Venus has been termed "earth's twin" because of the planets' similarity in size, mass, gravity and distance from the sun. This data from another earth-like planet has immediate practical applications to understanding earth's geology. It will also help us know more about the evolution of earth.

Esposito believes a major volcanic eruption occurred on the planet sometime around 1978, accounting for the abnormally high amounts of sulfur dioxide found in the Venusian atmosphere at that time. The eruption forced huge amounts of sulfur dioxide and small haze particles into the atmosphere sometime shortly before Pioneer Venus began its explorations. The sulfur dioxide in the gas rapidly formed into small aerosol particles of sulfuric acid similar to acid rain on earth. Pioneer has been recording the slow decay of the volcanic aftereffects ever since.

The unusual increase in sulfur dioxide was also observed by independent ground investigators in 1978. Earlier ground-based observations in the 1950s also detected a similar increase in sulfur dioxide.

Esposito believes the volcano was able to blow sulfur up as high as 70 km (40 mi.) through the super dense

atmosphere of Venus. He calculated the eruption as having at least 10 times more energy than any volcanoes on earth in the last 100 years, much larger in magnitude than even such explosions as the famous 1883 eruption of Krakotoa on Indonesia.

Esposito estimates surfur dioxide levels after the recent eruption of the Mexican volcano, El Chichon, were only 10 percent of the 1978 levels detected in the atmosphere of Venus.

Prior to 1978, the upper limit of sulfur dioxide in the Venusian atmosphere was close to two parts per billion. Using ultraviolet spectrometer recordings from instrumentation aboard Pioneer Venus, Esposito found levels of 100 parts per billion. These occurred shortly after the orbiter began circling the planet and have been tapering off gradually every since. Esposito reports sulfur is now returning to pre-1978 levels.

Some scientists have reservations, citing such possible alternative mechanisms for the build-up of sulfur dioxide as shifting winds blowing sulfur compounds up from the lower atmosphere. However, Esposito believes his data is very persuasive and consistent with phenomena on earth.

Esposito's theory is closely analogous to volcanous mechanisms on earth. After terrestrial volcanoes erupt, large amounts of sulfur-bearing gases, particularly sulfur dioxide, are injected into the atmosphere and dissipate over time. The day after the 1980 eruption of Mount St. Helens, the sulfur dioxide level in the region downwind from the volcano was 2,000 times the normal backgound level.

Are volcanoes active on Venus?

"We have no incontrovertible evidence," says Esposito, "but the data we do have are very persuasive. We can now understand why Venus looked so different in 1978 and we can understand the mechanism which is very similar to phenomena on earth."

If Venus is volcanically active, Masursky feels it is probably the third most active terrestrial planet, following earth and the small satellite of Jupiter, Io.

Esposito feels the question of volcanic activity on Venus will not be resolved entirely until 1988 when NASA plans to map Venus, using imaging radar. The Soviet spacecraft, Venera 15 and 16, are currently mapping Venus and preliminary data show volcanic cones.

The U.S. mission, Venus Radar Mapper, will use radar to see through the thick clouds and image the planet's surface. Radar on this spacecraft will have higher resolution and cover five times the surface area of Soviet efforts.

Research Grants Awarded to Alabama A&M University

Two research grants totaling $291,640 have been awarded by the Marshall Space Flight Center in Huntsville, Ala., to Alabama A&M University in Huntsville.

Center Director Dr. William R. Lucas presented the grants to Dr. Richard D. Morrison, president of Alabama A&M University, in a special ceremony in February. The total combined award is the largest ever made to that school by the Marshall Center.

The grants will enable the university to study an integrated computer-based research program in robotic systems, and an interactive analytical integration and mission planning data-base system to be used in a space station, according to Duron Crider of Marshall's Procurement Office.

The grants, amounting to $193,645 and $97,995, were made possible by funds from NASA Headquarters in support of an executive order signed by President Reagan in 1981. The order calls on government agencies to increase the participation in research by historically black colleges and universities.

The largest grant ever made to a college or university by the Marshall Center, $374,450, was presented in July 1983 to Tuskegee Institute. In August 1983, Tennessee State University was awarded a grant amounting to $235,632.

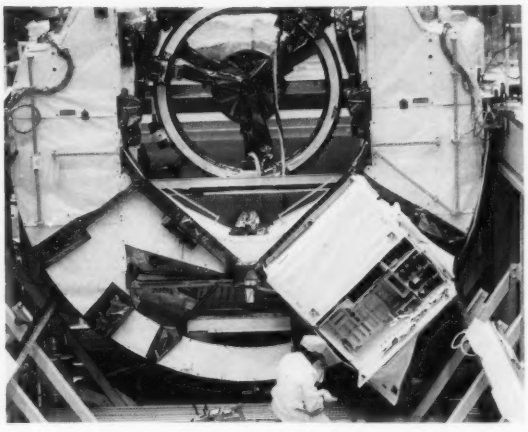
Marshall Space Flight Center Director Dr. William R. Lucas (right) and Dr. Richard D. Morrison, president of Alabama A&M University, Feb. 9 signed the documents formally awarding the university two research grants totaling $291,640.

Shuttle Mission 41-C—Pre-Launch Statistics

Crew:	Robert L. Crippen, Commander Francis R. Scobee, Pilot Terry J. Hart, Mission Specialist 1 James D. van Hoften, Mission Specialist 2 George D. Nelson, Mission Specialist 3
Orbiter:	Challenger (OV-099)
Launch site:	Pad 39A Kennedy Space Center, Fla.,
Launch date/time:	April 6, 1984, 9 a.m. EST*
Orbital inclination:	28.5 degrees
Altitude:	250 nautical miles
Mission duration:	6 flight days/143 hours, 12 minutes 91 full orbits; land on 92nd
Landing date/time:	April 12, 1984, 8:10 a.m. EST* 5 days, 23 hours, 12 minutes MET
Primary landing site:	Kennedy Space Center, Fla.
Payloads:	Long Duration Exposure Facility Fixed Service Structure (for Solar Max Repair) Radiation Monitoring Equipment Student Experiment—Comparison of Honeycomb Structures IMAX (cabin camera) Cinema 360 (payload bay camera)
Mission firsts:	First repair of a satellite in orbit First direct insertion ascent First flight of the Long Duration Exposure Facility

* Subject to change; mission elapsed times are approximate.

41-C crew (from the left): Robert L. Crippen, commander; Terry J. Hart, James D. van Hoften and George D. Nelson, all mission specialists; and Francis R. Scobee, pilot; below, technicians check out the "tool box" for the repair equipment to be used to replace a damaged module on the Solar Maximum Mission satellite.



Highlights:	Solar Maximum Repair Mission Long Duration Exposure Facility deployment
Principal mission activity:	The primary objective of flight 41-C is to retrieve, repair and restore to operation the Solar Maximum Mission satellite, launched Feb. 14, 1980. Two spacewalks are required—the first is to retrieve the satellite and begin repair operations; a second is required, after one day's rest, to replace the Main Electronics Box. The Long Duration Exposure Facility, a free-flying satellite, provides accommodations for experiments requiring long term exposure to the space environment. The LDEF will be carried to orbit, deployed and retrieved on a later flight and the experiments returned to the investigators for data analysis.

Summary of Major Activities

Flight Day 1
Fixed Service Structure checkout and positioning
Cinema 360 camera (payload bay)

Flight Day 2
Long Duration Exposure Facility deployment
IMAX camera (cabin)
Cinema 360 camera (payload bay)

Flight Day 3
Solar Maximum Mission repair activities:
- Rendezvous with Solar Max spacecraft
- Spacewalk to stabilize the satellite
- Grapple and berth operations
- Position Solar Max on Fixed Service Structure for repairs

IMAX camera (cabin)
Cinema 360 camera (payload bay)

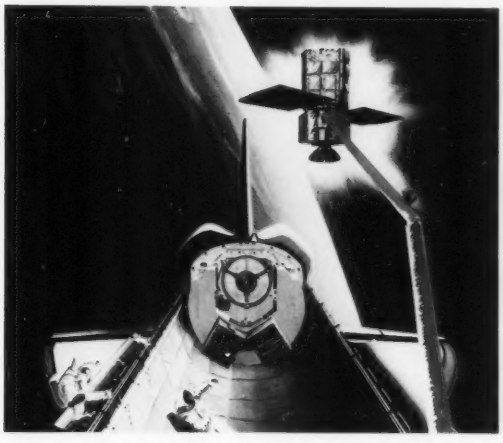
Flight Day 4
Student Experiment: Honeycomb Structures
IMAX camera (cabin)

Flight Day 5
Second extravehicular activity
Solar Maximum Mission repair activities:
- Spacewalk to changeout Main Electronic Box
- Grapple and unberth Solar Max satellite

IMAX camera (cabin)
Cinema 360 camera (payload bay)

Flight Day 6
Solar Maximum Mission satellite deployment
Radiation Monitor activities
IMAX camera (cabin)
Cinema 360 camera (payload bay)

Flight Day 7
Landing



Artist's concept of the Remote Manipulator Arm lifting Solar Max from the cargo bay after repairs are completed.

Cinema-360 Camera System Documents Shuttle Flights

A unique film camera system, Cinema-360, flew aboard the Space Shuttle Challenger flight 41-B (Feb 3-11). It was the first time a non-NASA motion picture production provided photographic documentation of activities aboard the Space Shuttle.

The flight was the first in a series of three for the camera system to film Shuttle mission activities with a 35mm camera fitted with a special "fisheye" lens.

The film project is the result of a joint endeavor agreement between NASA and Cinema-360, Inc., a nonprofit organization that develops educational films for planetariums. The film format is designed for showing in hemispheric planetarium domes.

Cinema-360 cameras are modified Arriflex 35mm Type III motion picture cameras. A Nikon F2.8 "fisheye" lens enables the camera to film activity within a field of view that is 180 by 360 degrees.

The Cinema-360 cameras were flown in the cabin area and the payload bay during the February Shuttle mission. The camera system will be flown in the payload bay only during two flights following the 41-B mission.

The footage shot aboard the Challenger will be used in the production of a documentary film entitled "An American Adventure," a half-hour motion picture in Eastman color.

Cinema-360 cameras will do extensive ground filming in addition to the on-orbit filming to provide the necessary footage for the motion picture. Later, the completed film will be made available in 16mm standard film and videotape formats.

Cinema-360, Inc., produces films on topics in natural history, travel, ecology and specialized footage for astronomy use.

The Davis Planetarium, operated by the City of Jackson, Miss., has primary production responsibility for the film. The Gannett Foundation, of Rochester, N.Y., has provided substantial funding for the production of the film. Numerous private firms and individuals have donated funds and provided technical support to the development of the special systems to be installed aboard the Challenger.

Crew Assignments Announced for Three Shuttle Missions

NASA has announced crew assignments for three Space Shuttle missions in 1985 and 1986.

The flights are mission 51-D, scheduled for launch in February 1985, 51-K scheduled in September 1985 and 61-D in January 1986.

Commander of 51-D will be Brewster H. Shaw, Jr., 38, of Cass City, Mich. Shaw's crew will consist of Bryan D. O'Connor, 37, of Twentynine Palms, Calif., pilot; and Mission Specialists Mary Cleave, PhD, 36, Southampton, N.Y.; Sherwood C. Spring, 39, Hartford Conn.; and Jerry L. Ross, 35, Crown Point, Ind.

Mission 51-D is to be the 21st Space Shuttle flight and the ninth for the orbiter Challenger. Principal objectives of the six-day flight will be deployment of a Syncom communications satellite and retrieval of the free-flying Long Duration Exposure Facility.

Named as mission specialists for 51-K were Bonnie Dunbar, PhD, a native of Sunnyside, Wash., and Guion S. Bluford Jr., Col., USAF, of Philadelphia, Pa. One of the three-member flight deck crew will be pilot Steven R. Nagel, Major, USAF, Canton, Ill.

The 51-K commander, another pilot and the European crew members will be announced at a later date. There will be a total of eight crew members eventually. Mission specialists are selected earlier since their training is more specialized and requires more time. NASA plans to have three-member crews share flight deck responsibilities on future Spacelab-type missions.

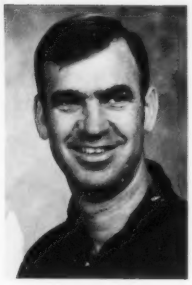
Spacelab D-1 is a dedicated mission purchased by the Federal Republic of Germany.

Mission specialists for mission 61-D will be James P. Bagian, M.D., 31, of Philadelphia; and Rhea Seddon, M.D., 36, of Murfreesboro, Tenn. John M. Fabian, 44, of Pullman, Wash., will fly as one of the pilots on 61-D. The commander and another pilot for 61-D will be named at a later date.

Brewster H. Shaw Jr.
Commander, 51-D

Bryan D. O'Connor
Pilot, 51-D

Mary L. Cleave
Mission Specialist, 51-D



John M. Fabian
Pilot, 61-D

James P. Bagian
Mission Specialist, 61-D

Rhea Seddon
Mission Specialist, 61-D

Sherwood C. Spring
Mission Specialist, 51-D

Jerry L. Ross
Mission Specialist, 51-D

Steven R. Nagel
Pilot, 51-K

Bonnie J. Dunbar
Mission Specialist, 51-K

Guion S. Bluford Jr.
Mission Specialist, 51-K

Tethered Satellite Development Underway

The concept of the Tethered Satellite System, the "satellite on a string" expected to be in orbit by late 1987, took a giant step closer to reality recently when NASA's Marshall Space Flight Center, Huntsville, Ala., exercised a firm option in its contract with Martin Marietta Aerospace, Denver, Colo., for fullscale development of the system.

The Tethered Satellite System is scheduled to be carried into orbit by the Space Shuttle. In orbit the satellite would be suspended either downward or upward from the Shuttle's cargo bay on a tether—a super-strong synthetic cord about a sixteenth of an inch thick and up to 60 miles in length. When deployed upward, as it will be for its maiden mission in 1987, the satellite will study electrodynamic and other scientific phenomena. Deployed downward, as it will be for later missions, the satellite will troll the earth's upper atmosphere for magnetospheric, atmospheric and gravitational data.

Prior to the beginning of full-scale development, Martin Marietta had completed engineering analyses and advanced development testing of selected components similar to those to be flown in space.

NASA is sharing development of the system jointly with the government of Italy. NASA will build the deployment system (the tether, reel, control system and related apparatus that would fit in the Shuttle orbiter's cargo bay) and Italy will build the satellite itself. NASA will also be responsible for systems integration and mission operations.

The first flight in 1987 calls for an upward deployment of the satellite. Once the Shuttle is in orbit, the satellite will be moved out about 40 feet by an extendible boom. The satellite will be checked out while at the tip of the boom and then released. As it moves upward away from the Shuttle, the reel will unwind until the satellite is at its proper distance for conducting electrodynamic experiments. As the Shuttle passes through the space plama—ionized gas particles surrounding the earth—the satellite, with its conducting tether, can become a generator, much as a copper coil moving within a magnet on earth can produce the flow of electricity. By drawing off the energy from the conducting tether and releasing it into space, scientists will be able to study magnetic lines of flux that surround the earth.

"In fact, we'll even be able to simulate some electrodynamic conditions of the other planets in the solar system," said Dr. Nobie Stone, project scientist. "For instance, one of the moons of Jupiter—Io—has volcanic activity that causes an ionosphere much like the Earth's to be formed. This makes Io a conducting body. As Io moves through Jupiter's magnetic field, a current is formed that flows from Io to Jupiter and back. From earth, we have observed bursts of electromagnetic radiation—radio waves, in other words—on Jupiter. We believe that these bursts come from this circular current flow between Io and Jupiter. By deploying the tethered satellite upward, we hope to simulate the conditions between these two bodies. The satellite would act as the conducting moon Io; and the earth, with its magnetic lines that the tethered satellite passes through, as Jupiter. In just this one example, we can learn more about the nature of electrodynamics as it pertains to our sister planets."

Future missions also call for a downward deployment. In this mode, the tethered satellite fills a need that has long existed in the study of the upper atmosphere. "Currently there are only limited means by which the upper atmosphere, around 60 to 90 miles up, can be studied," said James Sisson, manager of the Tethered Satellite System Project. "The upper atmosphere is a 'fringe' area—it's too high for airplanes and ballons to reach, but it's low enough that the orbits of low-altitude satellites decay from the aerodynamic drag after only a few hours." A number of instrument-laden rockets have been used with some limited success, but they pass through the upper atmosphere for only a few minutes before falling back to earth. "Besides," said Sisson, "these rockets travel primarily up and down, so they provide only a vertical look at one point in the upper atmosphere. The Tethered Satellite System, however, could be pulled through its extremely low, circular orbit—perhaps only 80 miles above the earth—to study the upper atmosphere for days at a time. This would allow scientists to map the global current systems known to exist."

The low orbit will permit experiments that map gravity and magnetic fields to achieve a higher resolution. Or the low orbit could provide a platform for atmospheric science measurements actually taken "on site," in the atmosphere itself, rather than by remote instruments.

Other possible applications of the tether system include radiation surveys, radio experiments, ocean topography mapping and sound propagation studies.

Whether the deployment is upward or downward, the satellite will be reeled back into the cargo bay of the orbiter at the conclusion of the experiment and returned to earth. This reusable satellite, with new or updated instruments—or perhaps even a different satellite and instrument complement—can then be reflown in the Shuttle to continue the promising variety of scientific experiments that have been proposed.

The formation of the U.S./Italian partnership began in 1980 when the Italian government's PSN/CNR (Italian National Space Plan/National Research Council) asked to collaborate with NASA on the Tethered Satellite System, which the U.S. agency had been studying since the mid-1970s. In 1981 a Letter of Agreement was signed by NASA and PSN/CNR that established the tasks each agency agreed to undertake during the study phase. Italy's primary effort in fulfilling its part of the agreement will be accomplished by its lead industrial firm Aeritalia. The agreement also provided for a science working group, co-chaired by NASA and PSN/CNR, to provide science requirements and to develop and recommend the scientific objectives of the Tethered Satellite System. A subsequent agreement has been negotiated to provide for the actual joint development project.

Headquarters Personnel Announcements

Dr. John J. Martin has been named NASA Associate Administrator for Aeronautics and Space Technology.

Martin comes to NASA from the Bendix Advanced Technology Center in Columbia, Md., where he had been vice president and general manager since 1979. After two years at North American Aviation, Martin first joined Bendix in 1953, leaving in 1960 to join the Institute for Defense Analyses.

In 1969 he joined the staff of the President's Science Advisor at the White House where he was responsible for intelligence, strategic systems and general purpose forces and for working with the National Security Council, Office of Management and Budget, the Department of Defense and intelligence agencies.

In 1973-74, Martin was the associate deputy to the Director of Central Intelligence for the Intelligence Community, which involved management of national foreign intelligence programs.

He was appointed principal Deputy Assistant Secretary of the Air Force in 1974 and, in 1976, was named Assistant Secretary of the Air Force for Research, Development and Logistics.

Joseph A. Kratovil has been named NASA's Chief, Industry Affairs Office in the Technology Utilization and Industry Affairs Division, Office of External Relations.

In this position, he will serve as the liaison and coordinator of NASA's relationships with industry. Kratovil comes to this new post from a special assignment at the White House on the President's Reform '88 initiatives.

Kratovil first joined NASA in 1964 as director of resources management at Johnson Space Center, Houston, after 12 years with North American Aviation, Inc. In 1971, he left the agency to become executive director for business and administration for the New York Board of Education.

In 1980, Kratovil returned to NASA Headquarters in Washington as director of resources management and administration in the Office of Space Transportation Systems Operations.

Contractor News

Johnson Space Center, Houston, has signed a cost-plus-award-fee contract with **Rockwell International Corp.,** Downey, Calif., for launch support activities at NASA's Kennedy Space Center, Fla. Valued at $23,577,000, the contract provides for Rockwell corporate memory and continuity for the JSC Design Center at Kennedy. Rockwell is the builder of the Space Shuttle orbiter. Effective Feb. 4, 1984, the contract ends Dec. 31, 1985, with no options for renewal.

Lewis Research Center, Cleveland, Ohio, has awarded a $20.4 million contract to **General Electric Co.** in Cincinnati, Ohio, for a large-scale, feasibility assessment of a modern counterrotation unducted propfan engine concept. The planned multi-year effort consists of design, fabrication and large-scale ground testing of the propfan engine concept using a modified GE 404 engine as a research testbed. The engine will deliver 25,000 pounds of thrust at sea-level static

conditions. Work is to be performed at General Electric's Evandale, Ohio, facilities.

Ames Research Center, Mountain View, Calif., will install one of the world's most advanced computers in its Computer Facility. Ames will lease the computer from **Control Data Corp.,** Minneapolis, Minn., for a one-year period beginning June 4, 1984. The agreement provides two additional one-year priced options. Value of the three-year agreement, including maintenance and software, is $13.2 million. The computer, a Cyber 205, will be used for fluid dynamics, chemical modeling, aerothermodynamics and other computationally intensive research at the center.

Goddard Space Flight Center, Greenbelt, Md., has awarded a cost-plus-incentive-fee contract to **McDonnell Douglas Astronautics Co.,** St. Louis, Mo., in the amount of $10,350,000 for a modular power subsystem for the Gamma Ray Observatory. The subsystem conditions solar array power for satisfaction of electrical loads and rechanging of nickel-cadmium batteries. Energy stored in the batteries is delivered to using equipment in eclipse and to supplement solar array power when necessary to satisfy load demand. Power can also be supplied to the system from external sources during ground operations, limited operation in the Shuttle orbiter payload bay or retrieval operations. Delivery of two units is scheduled for July 1986 for integration into the Gamma Ray Observatory, scheduled for launch in May 1988.

Goddard Space Flight Center's Wallops Flight Facility, Wallops Island, Va., has selected **Datacom** of Fort Walton Beach, Fla., to negotiate a firm fixed-price contract for replacement of the Goddard/Wallops data processing system. The contract, effective April 15, 1984, calls for the purchase of five computer systems having both network and independent operational capabilities, simultaneously. The systems will provide data processing support for aeronautical, space and environmental research experimentation, as well as administrative data processing support. Total proposed price for this effort is $4,359,000.

PRODUCTIVITY STEERING COMMITTEE MEETS—NASA's Productivity Steering Committee held its third meeting Jan. 12 and 13 at Hewlett-Packard Corp. in Cupertino, Calif. Participants included (from the left): Front row: C.A. Syvertson, Ames Research Center, Mountain View, Calif.; John Boyd, Patrick A. Templeton, Philip E. Culbertson, NASA Headquarters, Washington, D.C.; Roy S. Estess, National Space Technology Laboratories, Bay St. Louis, Miss.; Robert Aller, Harriett Jenkins, Headquarters; Ken Jacobs, Goddard Space Flight Center, Greenbelt, Md.; Larry Milov, Headquarters; and Gerald Griffin, Johnson Space Center, Houston, Texas. Back: Richard H. Peterson, Langley Research Center, Hampton, Va.; Milton A. Silveira, Lt. Gen. James A. Abrahamson, David Braunstein, Headquarters; Lew Allen, Jet Propulsion Laboratory, Pasadena, Calif.; Stuart Evans, James C. Elmes, John Martin, Headquarters; Noel Hinners, Goddard; Donald Hearth, Langley; Charles T. Newman, Headquarters; William R. Lucas, Marshall Space Flight Center, Huntsville, Ala.; and James M. Beggs, NASA Administrator.

NASA Photo Techniques Help Preserve Fine Art

NASA space photography techniques were recently used to investigate the best means of preserving a manuscript of the 16th century artist and scientist Leonardo da Vinci.

Scientists at NASA's Jet Propulsion Laboratory, Pasadena, Calif., worked with conservators at the Los Angeles County Museum of Art to determine whether mounting techniques were causing any damage to the Codex Hammer, a collection of Leonardo's illustrated notes on astronomy, water, light, mechanics and earth sciences, compiled between 1506 and 1508.

One method used to study the documents involved use of a portable photographic system that is based on a JPL-Caltech camera system for NASA's Hubble Space Telescope and the Galileo spacecraft for the 1986 mission to Jupiter.

Another technique involved computer processing and enhancement of photographs of the documents in JPL's Image Processing Laboratory.

Each method was used to assess whether current mounting and preservation techniques adequately protect old documents from environmental changes that could cause infinitesimal but permanent damage to the works.

The Codex hammer, formerly called the Codex Leicester, was purchased by collector Armand Hammer in 1980. (Codex is a classical Latin term meaning "manuscript.")

The Codex, in an 18th century binding when purchased by Hammer, was unbound by conservators to better preserve the document and to permit public display of individual sheets. The 18, two-sided sheets of the Codex were encapsulated between two thin layers of Plexiglas so that both sides of each sheet may be viewed. (The mounting method was devised at the British Museum and is extensively used at the Royal Library at Windsor Castle, England.)

The goal of the mounting technique is very long-term preservation of the paper. While the encapsulation attempts to isolate the paper from physical contact with the surrounding atmosphere, changes in humidity, pressure and temperature are transmitted through the walls of Plexiglas. In addition, the rough-textured paper is, in some areas, in direct contact with the Plexiglas.

JPL and museum researchers simulated the mounting used for the Codex with 18th century paper. Computer image processing of photographs of the paper enabled the researchers to enlarge and examine millimeter-sized areas of the paper for evidence of warping or microburnishing, where paper fibers rub against the Plexiglas encapsulation.

While no evidence of microburnishing was found, researchers did see evidence that small portions of the paper had stretched or shrunk slightly. According to museum conservator James Druzik, such stretching could seriously damage old documents over time.

Museum officials and the Armand Hammer Foundation prevent such damage by taking measures to protect the documents from temperature or humidity extremes in transport and during exhibition.

In other testing, researchers used a camera called a charge-coupled device, or CCD, to photographically study the Leonardo works. The CCD is capable of resolving a scene into more than 1,000 shades of gray. By contrast, high quality film can record only 50 or fewer gray levels, and the human eye can discern about 16 shades of gray. Consequently, computer processing is required to display even a small fraction of the information contained in a CCD image.

Art conservators expect that, in the near future, space observation and image processing techniques will find widespread use in art conservation laboratories.

The Soaring Society of America, Inc., presented a Certificate of Appreciation to Langley Research Center, Hampton, Va., for its "continued contribution to the art, sport and science of motorless flight and its support of the Society's annual National Soaring Week programs." Floyd Sweet (left), Regional Director of the Society, presented the certificate to Langley's Director Donald Hearth on Feb. 23.

Patents for Inventions From NASA Research

The Office of General Counsel, NASA Headquarters, announces the following U.S. patents have been issued by the U.S. Patent Office and Trademark Office to NASA for inventions resulting from NASA research. Inquiries concerning them should be directed to the attention of the NASA Patent Counsel of the indicated installation.

Inventor(s) & Employer	Title	Patent No.	Installation
Donald F. Schultz, NASA/LeRC	Heat pipes to reduce engine exhaust emissions	4,429,537	LeRC
Robert C. Bill, Donald W. Wisander; NASA/LeRC	Method of fabricating an abradable gas path seal	4,430,360	LeRC
Phil M. Salomon, Kalman Smilowitz; Caltech/JPL, Pasadena, Calif.	Programmable scan/read circuitry for charge coupled device imaging detectors	4,430,673	NRO-JPL
Joseph A. Chandler, NASA/JSC	Apparatus for releasably connecting first and second objects in predetermined space relationship	4,431,333	JSC
Paul M. Hergenrother, NASA/LaRC	Ethynyl and substituted ethynyl-terminated polysulfones	4,431,761	LaRC
Roger S. Estey, Michael F. Hanna; Caltech/JPL, Pasadena, Calif.	Method and apparatus for precision control of radiometer	4,431,306	NRO-JPL
Terry L. St. Clair, NASA/LaRC; James F. Wolfe, Thomas D. Greenwood; Virginia Polytechnic Institute and State University, Blacksburg, Va.	Thermoset-thermoplastic aromatic polyamide containing N-Propargyl groups	4,431,792	LaRC
Frank J. Nola, NASA/MSFC	Three phase power factor controller	4,433,276	MSFC
Bruce A. Banks, NASA/LeRC	Method of making an ion beam sputter-etched ventricular catheter for hydrocephalus shunt	4,432,853	LeRC
Indra K. Varma, George M. Fohlen, John A. Parker; National Research Council, Washington, D.C.	Phosphorus-containing imide resins	4,433,115	ARC
Isidor Zaplatynsky, NASA/LeRC	Method and apparatus for coating substrates using a laser	4,434,189	LeRC
Robert R. Hale, Allan R. McDougal; Caltech/JPL, Pasadena, Calif.	Solar energy modulator	4,433,672	NRO-JPL
Michael J. Kavaya, Robert T. Menzies; Caltech/JPL, Pasadena, Calif.	Spectrophone stabilized with line center offset frequency control	4,434,490	NRO-JPL
Kenneth R. Sidman, Irving J. Arons, Richard P. Tschirch; Arthur D. Little, Inc., Cambridge, Mass.	Heat resistant protective hand covering	4,433,439	JSC
Ivan D. Wells, Jin L. Koh, Marvin Holmes; Caltech/JPL, Pasadena, Calif.	Wind and solar powered turbine	4,433,544	NRO-JPL
Robert W. Rosser, NASA/ARC; Timothy S. Chen, Chung-Heng Cheng; San Jose State University, Calif.	Process for preparing perfluorotriazine elastomers and precursors thereof	4,434,106	ARC

What's New in NASA Television and Radio Programming

Programs released in February:

Television

Aeronautics & Space Report
(4½ minutes plus 90-second versions):

Aircraft Stall/Spin Research

Radio

Space Story (4½-minute programs):

A Look at 1984 . . . (featuring James M. Beggs, NASA Administrator)
Space Goes Commercial (featuring James M. Beggs)
Repairing Solar Max . . . The Next Mission (featuring the 41-C crew astronauts Robert Crippen, Francis Scobee, Terry Hart, James van Hoften and George Nelson)
Looking Deep into the Universe (featuring Dr. Edward J. Weiler, NASA Headquarters)

Special Report (14½-minute program):

A Look into the Future . . . featuring James M. Beggs

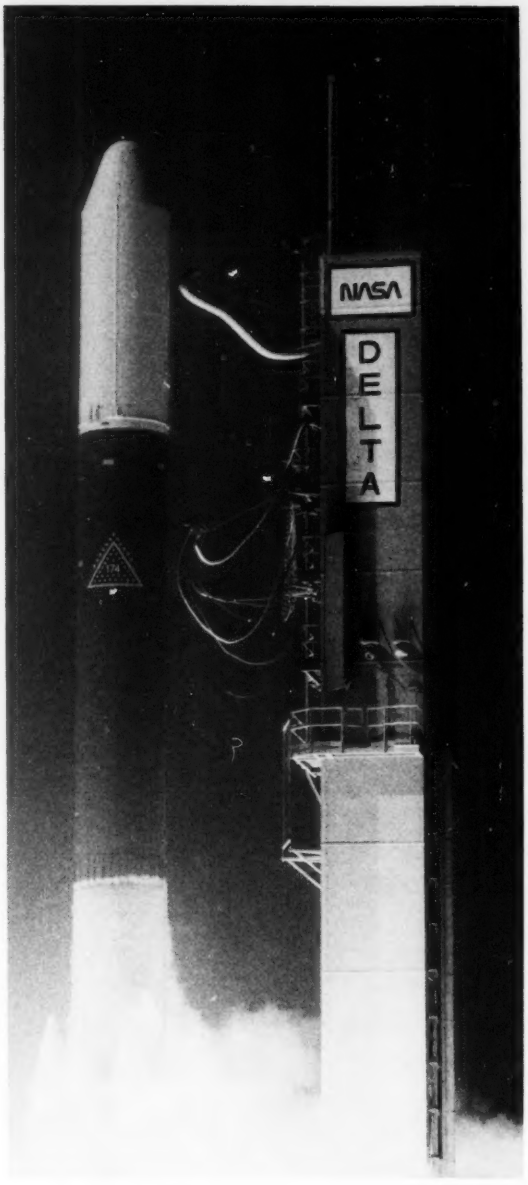
The following radio program is featured in Spanish:

El Informe Espacial

Reparando Satelites en Orbita (featuring astronaut Franklin Chang-Diaz)

Copies of television tapes are sent simultaneously to all NASA Visitor Information Centers and Public Affairs Offices, and to 650 television stations nationwide as well as to 425 cable television systems via the satellite RCA-Cablenet 1. Five hundred television stations receive material formatted as a 4½-minute program; the remaining 150 stations receive a 90-second "spot"—a condensed version of the 4½-minute presentation.

NASA's radio programs are sent to approximately 3,500 radio stations across the nation; in addition, translations of the recordings are made by Voice of America and Radio Free Europe and these tapes are then released to the appropriate audiences overseas. Released each month are one report of 14½-minutes and four 4½-minute weekly stories (one story in the set is featured for one week of the month). Ten one-minute space notes are released quarterly.



LANDSAT 5 LAUNCH—Landsat 5, the second of a new generation of earth resources satellites, was launched at 9:59 a.m. PST, March 1 from the Western Space and Missile Center, Vandenberg Air Force Base, Calif. A secondary payload, the University of Surrey Satellite (UOSAT), a British amateur radio and scientific research satellite, was mounted on the second stage of the Delta vehicle. The Delta 174 mission marked the end of an era—the 18-year, 39 mission string of Delta missions launched from NASA facilities near Vandenberg's Purisima Point. The Delta's program will be concluded at Kennedy Space Center with last launch scheduled for 1986.

1984 Launch Activity

Space Shuttle Launches

Date	Mission	Orbiter	Launch Site*	Mission Remarks
Feb 3	41-B	Challenger	KSC	Payload: SPAS-01A, Palapa B-2, Westar-VI; successful launch
April 6	41-C	Challenger	KSC	Payload: Solar Max Repair Mission; Long Duration Exposure Facility
June 4	41-D	Discovery	KSC	Payload: Telesat-I, Syncom IV-1, Large Format Camera, OAST-1; first flight of Discovery
Aug 9	41-F	Discovery	KSC	Payload: Telstar 3-C, SBS-D, Syncom IV-2, SPARTAN-1
Aug. 30	41-G	Columbia	KSC	Payload: OSTA-3, ERBS, SPARX-1
Sept. 28	41-H	Challenger	KSC	Payload: DOD mission or TDRS-B
Oct. 24	51-A	Discovery	KSC	Payload: MSL-1, Telesat-H, GAS Bridge
Nov. 21	51-B	Challenger	KSC	Payload: Spacelab 3
Dec. 17	51-C	Discovery	KSC	Payload: TDRS-B or TDRS-C, MSL-2

Satellite Deployments from the Space Shuttle

Date	Mission	Launch Vehicle	Launch Site*	Mission Remarks
Feb. 3	Westar-VI	PAM-D	41-B	Western Union communications; successful deployment from STS 41-B; satellite failed to achieve geosynchronous orbit
Feb. 6	Palapa B-2	PAM-D	41-B	Indonesia communications; successful deployment from STS 41-B; satellite failed to achieve geosynchronous orbit
June 4	Telesat-I	PAM-D	41-D	Canadian communications
June 5	Syncom IV-1	UUS	41-D	Hughes communications
Aug. 9	SBS-D	PAM-D	41-F	Satellite Business Systems commercial communications
Aug. 10	Syncom IV-2	UUS	41-F	Hughes communications
Aug. 11	Telstar 3-C	PAM-D	41-F	AT&T communications
Sept. 28	TDRS-B(?)	IUS	41-H	NASA communications
Oct. 24	Telesat-H	PAM-D	51-A	Canadian communications
Dec. 17	TDRS-B or C	IUS	51-C	NASA communications

Expendable Launches

Date	Mission	Launch Vehicle	Launch Site*	Mission Remarks
March 1	Landsat 5	Delta	WSMC	NOAA earth observation; launch successful
May 17	Intelsat V-G	Atlas Centaur	ESMC	Intelsat international communications
May 24	Galaxy-C	Delta	ESMC	Hughes commercial communications
August	NOAA-F	Atlas-F	WSMC	NOAA weather satellite
August	Intelsat VA-A	Atlas Centaur	ESMC	Intelsat international communications
Aug. 2	AMPTE	Delta	ESMC	Active Magnetospheric Particle Tracer Explorer; space physics — NASA cooperative with Germany
September	NATO-IIID	Delta	ESMC	North Atlantic Treaty Organization communications
November	Intelsat VA-B	Atlas Centaur	ESMC	Intelsat international communications
December	San Marco D/L	Scout	SMR	International cooperative with Italy
4th Qtr.	AF-16 (ITV-1)	Scout	WFF	U.S. Air Force
4th Qtr.	Navy-21	Scout	WSMC	U.S. Navy

*** Launch Sites:**
ESMC—Eastern Space and Missile Center, Fla.; KSC—Kennedy Space Center, Fla.; SMR—San Marco Range, Indian Ocean; Space Shuttle Orbiter Challenger: 41-B, 41-C, 41-E, 41-H, 51-B; Space Shuttle Orbiter Columbia: 41-G; Space Shuttle Orbiter Discovery: 41-D, 41-F, 51-A, 51-C; WFF—Wallops Flight Facility, Wallops Island, Va.; WSMC—Western Space and Missile Center, Vandenberg Air Force Base, Calif.

Another Dividend from Air and Space

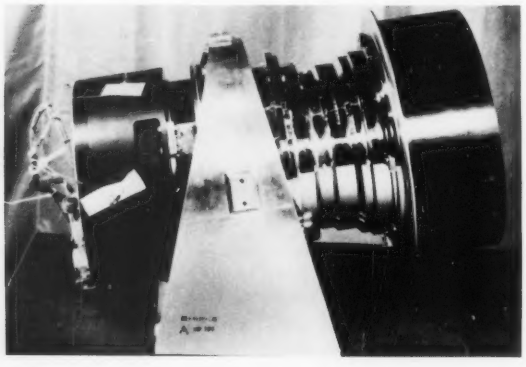
Research and development in aeronautics and space have provided numerous benefits for all Americans—and at a tiny percentage of the tax dollar. Here is an example:

Star Mapper

Perkin-Elmer Corp., Norwalk, Conn., prime contractor for the Optical Telescope Assembly of NASA's Space Telescope, is conducting research on advanced space astronomy systems that will be operating in the 1990s and beyond. A major requirement of such systems is an exquisitely accurate method of pointing—aiming the spacecraft's telescope, camera and other instruments. The instruments may have to point for a long time at a single star, while in other instances they may have to change pointing angles in a smooth, continuous sweep to scan a large region of the heavens. For precision pointing and estimation of the spacecraft's attitude, Perkin-Elmer's Optical Technology Division, Danbury, Conn., is developing new types of sensors, such as the star mapper pictured.

Because earlier star mappers using photoelectron tube detectors cannot easily meet the stringent pointing requirements, Perkin-Elmer is concentrating its development efforts on "charged coupled device" detectors, or CCDs. CCDs are microelectronic silicon chips that sense starlight and convert it to electrical signals, which are processed to determine the attitude of the spacecraft. Attitude determination provides accurate measurement of pointing angles.

In computerized simulations of star sensor performance, Optical Technology Division engineers use a computer program Center (COSMIC). Known as Skymap Star Catalog and Data Base, the program provides an accurate star map of any part of the sky. Skymap is used to determine the number of stars that can be detected by the CCD sensors, information necessary to the design of an opitcal system of proper size and field of view. Perkin-Elmer reports that the Skymap software has allowed them to confirm the design integrity of their star sensors, which provide extraordinary accuracies and represent a major advance in optical technology.



*NASA does not endorse commercial products developed as a result of its Technology Utilization or Patent Licensing Programs, but it does encourage the widest possible use of its technology.

NASA
National Aeronautics and Space Administration